


Renewable Energy & Pakistani Economy in 21st Century



Adeel Ghayur

PIDE



Scheme of Presentation



- Introduction
- Three thrusts for Renewable Energies
 - ◆ Economic
- Brazil Proalcool Program
- Pakistan Energy Mix
- Initiatives in Projects in Renewable Energies
- Holistic View of Input vs. Output
- A New Strategy
- Rural Electrification Under New Strategy
- Recommendations



Introduction



- Energy is the blood in today's economies
- Oil pumped through these economic engines in 20th century
- Renewable energies will keep these economic engines going in 21st century

Three Thrusts Behind Renewable Energy

- Economic (Fuel Prices)
 - ◆ Brazil
- Social (Climate Change)
 - ◆ Denmark
- Political (Foreign Oil)
 - ◆ USA

Economic Factor – Fuel Prices

- Continuously increasing fossil fuel price
 - ◆ Governments inclined to look elsewhere
- Many benefits of converting to local renewable energy source
 - ◆ Foremost – saving billions in foreign exchange
- Brazil is the best example

Brazil

- 1973 – the Arab Israel War
 - ◆ Oil embargo imposed
- Brazil's economy was severely hit
 - ◆ Importing 80% of its oil
 - ◆ Economy slid into recession
 - ◆ 40% of foreign exchange spent on oil
- 1975 – Brazilian Govt. decided to reduce reliance on imported oil
 - ◆ Ambitious Proalcohol Program was launched

Brazil – Proalcool Program

- This is world's largest commercial renewable energy effort
- Convert country's total petroleum supplies to a blend of 10% Ethanol and 90% petrol (E-10)
- The Iranian Revolution
 - ◆ Brazil's economy survives
 - ◆ Brazil converts to E-25

Brazil – Proalcool Program cont...

- As part of Proalcool Program the government offered following incentives
 - ◆ Credit guarantees and low-interest loans for new refineries
 - ◆ State trading enterprise for purchasing ethanol at favorable prices
 - ◆ Petrol prices were set at a price to give ethanol a competitive advantage
 - ◆ “Let’s unite, make alcohol” marketing program
 - ◆ Petrobras (state-owned oil company) invested for distribution of ethanol throughout the country

Brazil – Proalcool Program cont...

- **Achievements of Proalcool Program**
 - ◆ 500% increase in ethanol production between 1975-1979
 - ◆ Started manufacturing ethanol driven cars
 - ◆ Ethanol provides 40% of total fuel for cars
 - ◆ 70% of cars in Brazil are flex-fuel cars
 - ◆ Reduction of imported oil
 - 81% in 1980
 - 47% in 1990
 - 10% in 2002
 - ◆ Now beginning to export

Other Success Stories

- Social Factor

- ◆ Denmark
- ◆ Using Wind Power

- Political Factor

- ◆ USA
- ◆ Using any resource possible, e.g. ethanol, solar, fuel cell

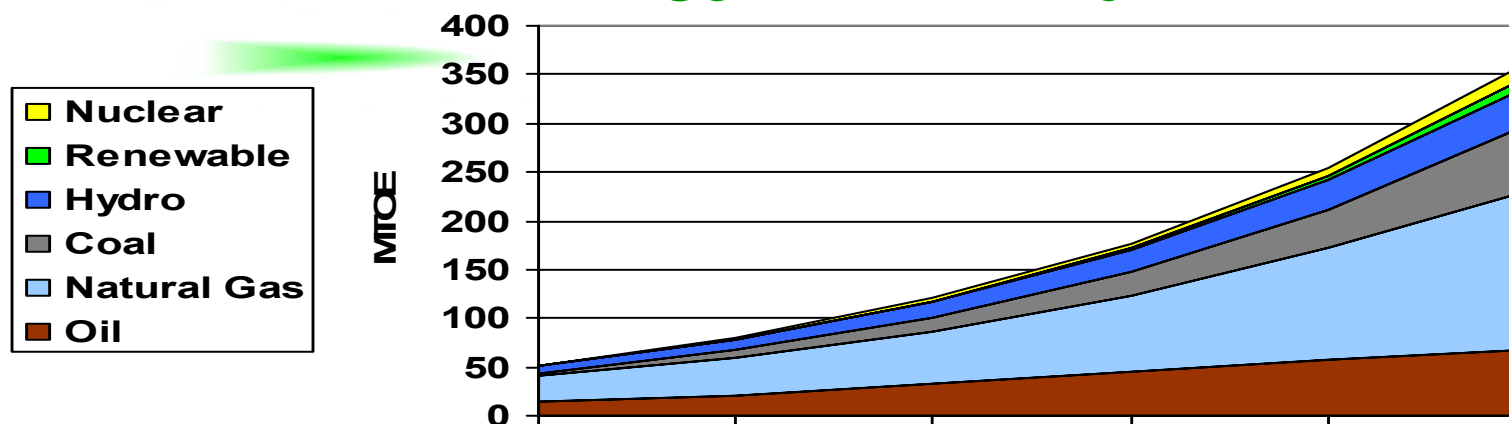
Pakistan

A horizontal bar with a green gradient, transitioning from a lighter shade on the left to a darker shade in the center, and then back to a lighter shade on the right. It is positioned below the word 'Pakistan'.

Pakistan Energy Mix (MTOE)

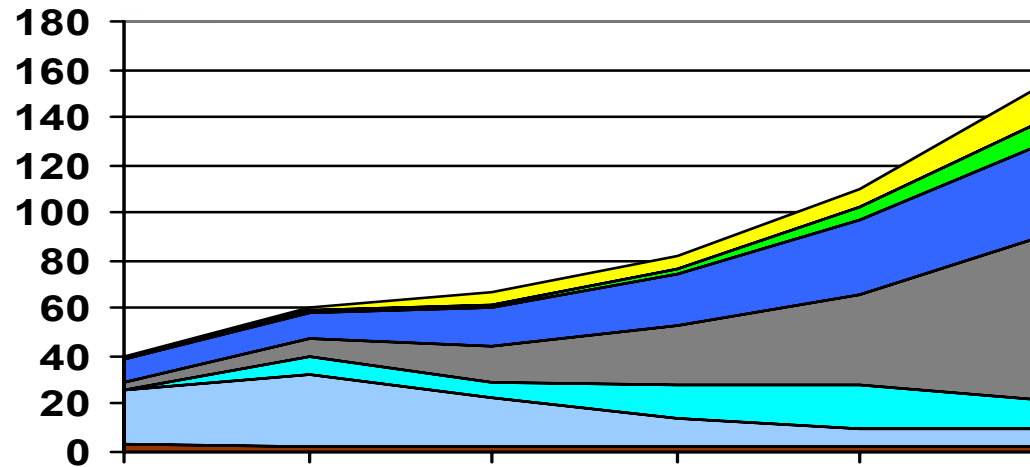
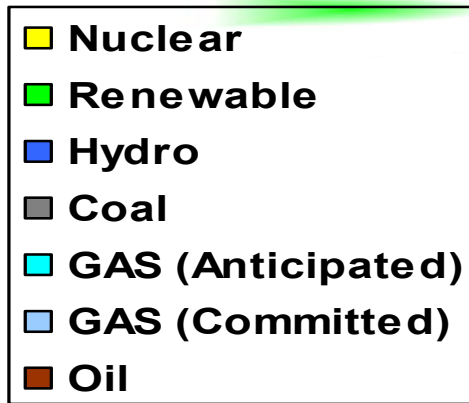
- Energy Demand = 54.05
- Energy Supply = 55.04
- Through indigenous sources = 39.38
- Through imports (oil & coal) = 15.66
- Expected demand in 2030 = 361.82
 - ◆ 6.7 times more than today

Pakistan's Energy Mix Projections



	2005	2010	2015	2020	2025	2030
Oil	16.80	20.69	32.51	45.47	57.93	66.84
Gas	27.10	38.99	52.98	77.85	114.84	162.58
Coal	3.3	7.16	14.45	24.77	38.28	68.56
Hydro	6.43	11.03	16.4	21.44	30.5	38.93
Renewable	0	0.84	1.6	3	5.58	9.2
Nuclear	0.42	0.69	2.23	4.81	8.24	15.11
Total	54.05	79.4	120.16	177.34	255.37	361.82

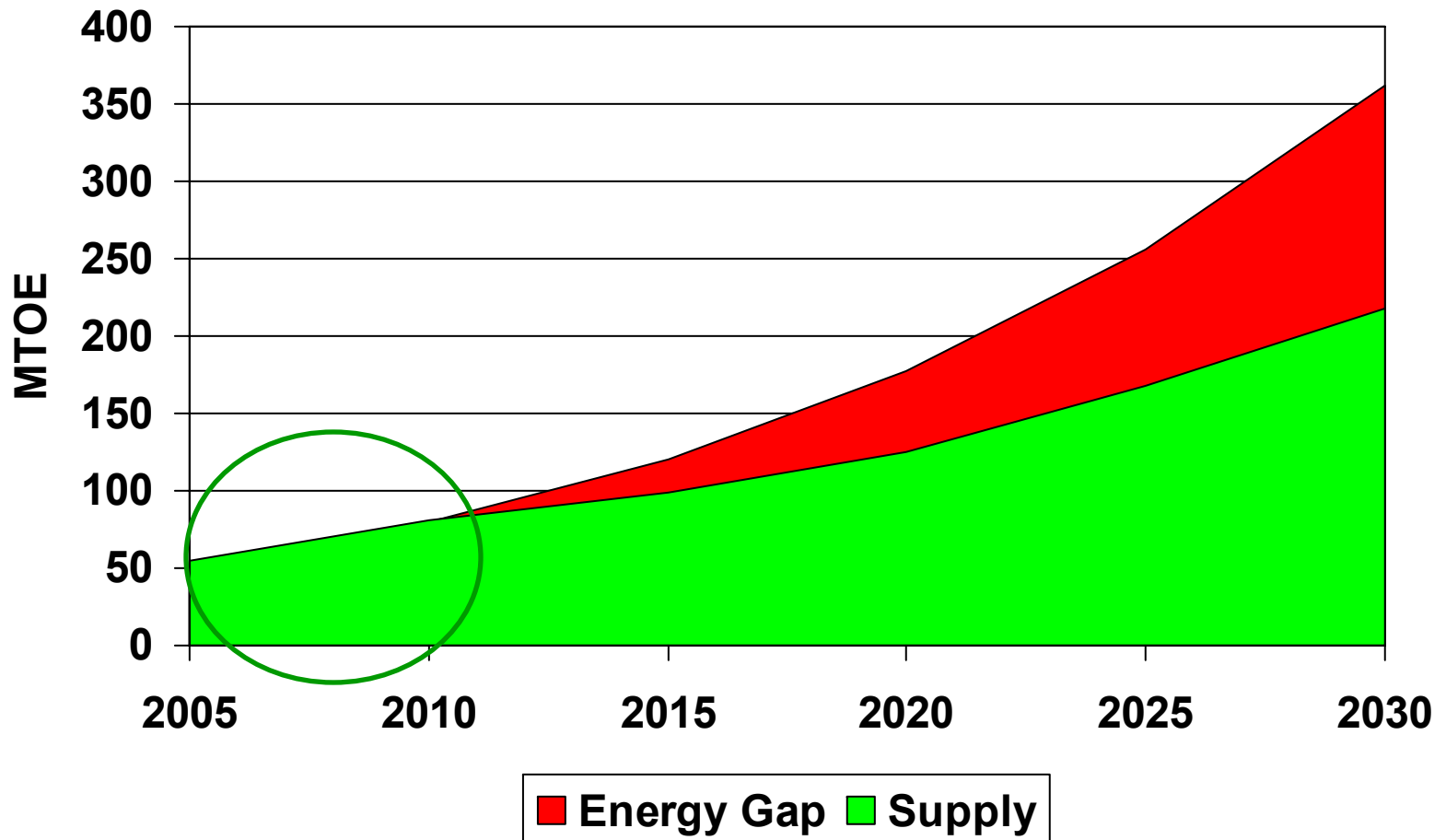
Indigenous Supply Projection



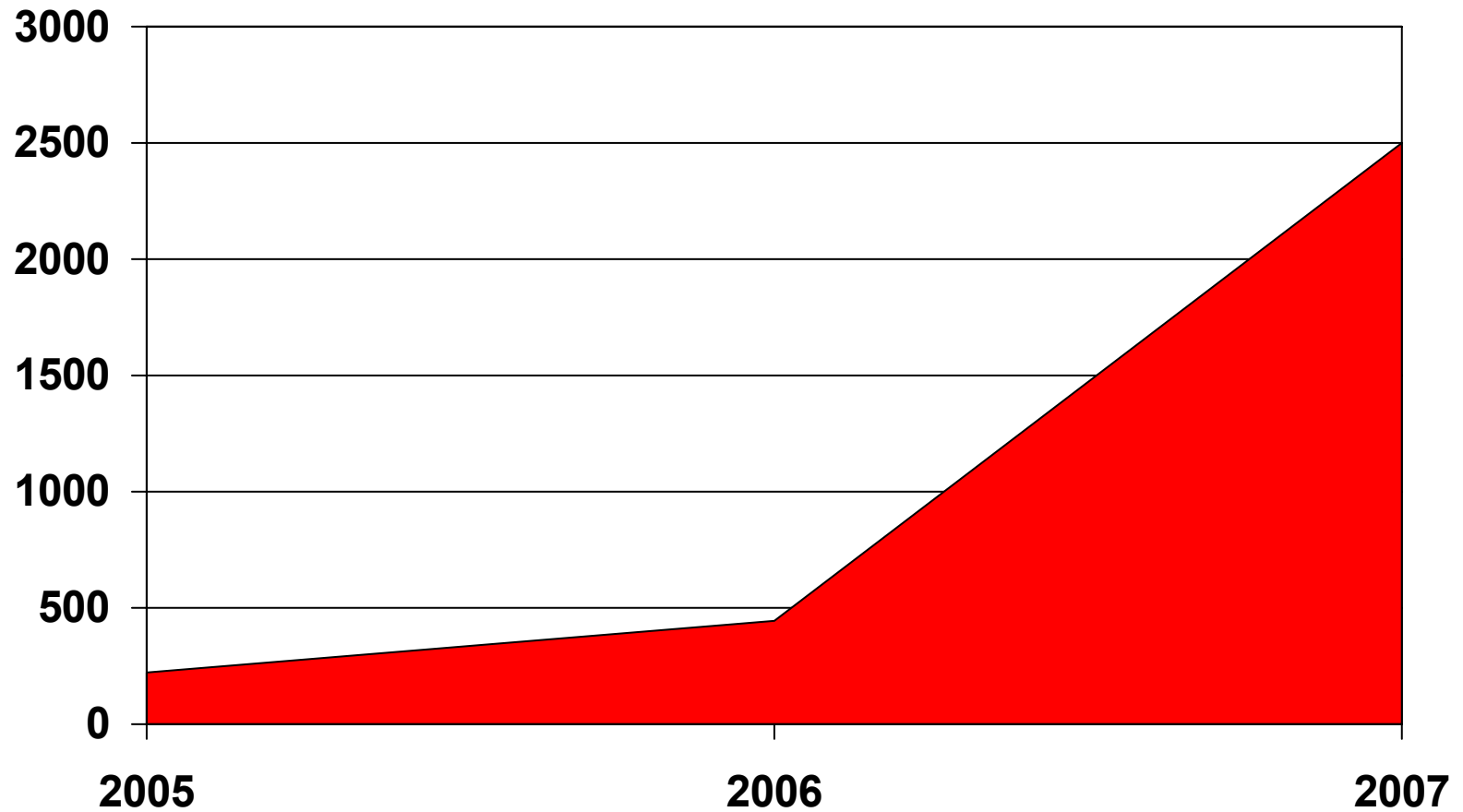
	2005	2010	2015	2020	2025	2030
Oil	3.62	2.2	2.18	2.2	2.2	2.2
GAS (Committed)	22.3	29.93	20.22	11.81	7.29	7.29
GAS (Anticipated)	0	7.85	6.68	13.82	18.34	12.35
Coal	3.49	7.4	14.81	24.77	38.28	68.65
Hydro	9.24	11.03	16.4	21.44	30.5	38.93
Renewable	0	0.84	1.6	3	5.58	9.25
Nuclear	0.73	0.69	4.81	4.81	8.24	15.11
Total	39.19	59.94	66.70	81.85	110.43	153.78

16-Aug-07

Projected Gap between Supply and Demand [MTDF]



Electricity Gap between Supply and Demand – Factual



Short Term Solution for Electricity Shortfall

- Pakistan needs electricity – quickly
- Choices:
 - ◆ Diesel Power Plants
 - ◆ Solar Power Plants
 - ◆ Wind Power Plants
- Coal and Hydro Power Plants are usually many times bigger but take a lot longer to setup
- The Solution:
 - ◆ Setup and erect small renewable energy power plants at number of locations to meet the current shortfall

Pakistan's Renewable Energy Potential

Source	Potential (MW)
Solar	∞
Wind	50,000
Hydro	46,000
Biofuels	~
Others	~

Pakistan's Key Energy Strategies for 21st Century

- ***“Development of hydropower resources as they are cheap and eco-friendly. This will not only provide more energy but also regulate the flow of water to the sea.***
- Extensive use of coal-fired plants...
- Meet fully the oil and gas exploration targets...
- In line with global trends, Oil and Gas Development Corporation...
- Promote efficient use of energy...
- Encourage efficient power generation ...
- Make buildings more energy efficient, ...
- Reduce vehicle emissions ...
- ***Accelerate the current programs in alternate energy (specially for wind), which have the potential to provide more than 5 per cent of the electricity supply needed in 2030 as incorporated in the Energy Security Plan.***
- Build up the local power engineering industry...
- ***Initiate research in emerging thrust areas such as fusion, fuel cells, and hydrogen for energy generation and storage***
- Broaden the data base through regular census...

Initiatives Taken by Provincial and Federal Governments



Actions Taken and Outputs Achieved

Punjab

- Punjab Vision 2011
 - ◆ Develop renewable energies
- Project proposed to promote use of solar and biogas energy
 - ◆ Installation of family size biogas plants at 5000 farms in the Punjab
 - ◆ Currently there is no project in the implementation phase
- 48 points identified over canals for small hydropower stations
 - ◆ None erected so far

Balochistan

- Government of Balochistan plans to undertake the following projects
 - ◆ Installation of windmill and solar energy systems
 - Cost @ Rs.200.00 million
 - ◆ Detailed feasibility study for the remaining area for solar and wind projects
 - Cost of Rs. 20.00 million

Sindh

- Government of Sindh intends to
 - ◆ Electrify 806 villages in costal areas through wind mills

Federal Government

- Carry out research and erect renewable energy plants to reach a share of 10% in total energy mix
- Create a body to promote and encourage renewable energy development
 - ◆ Alternative Energy Development Board (AEDB) created in May 2003
- Carry out research in renewable energy
 - ◆ Pakistan Council for Renewable Energy Technologies (PCRET) created in May 2001

Alternative Energy Development Board

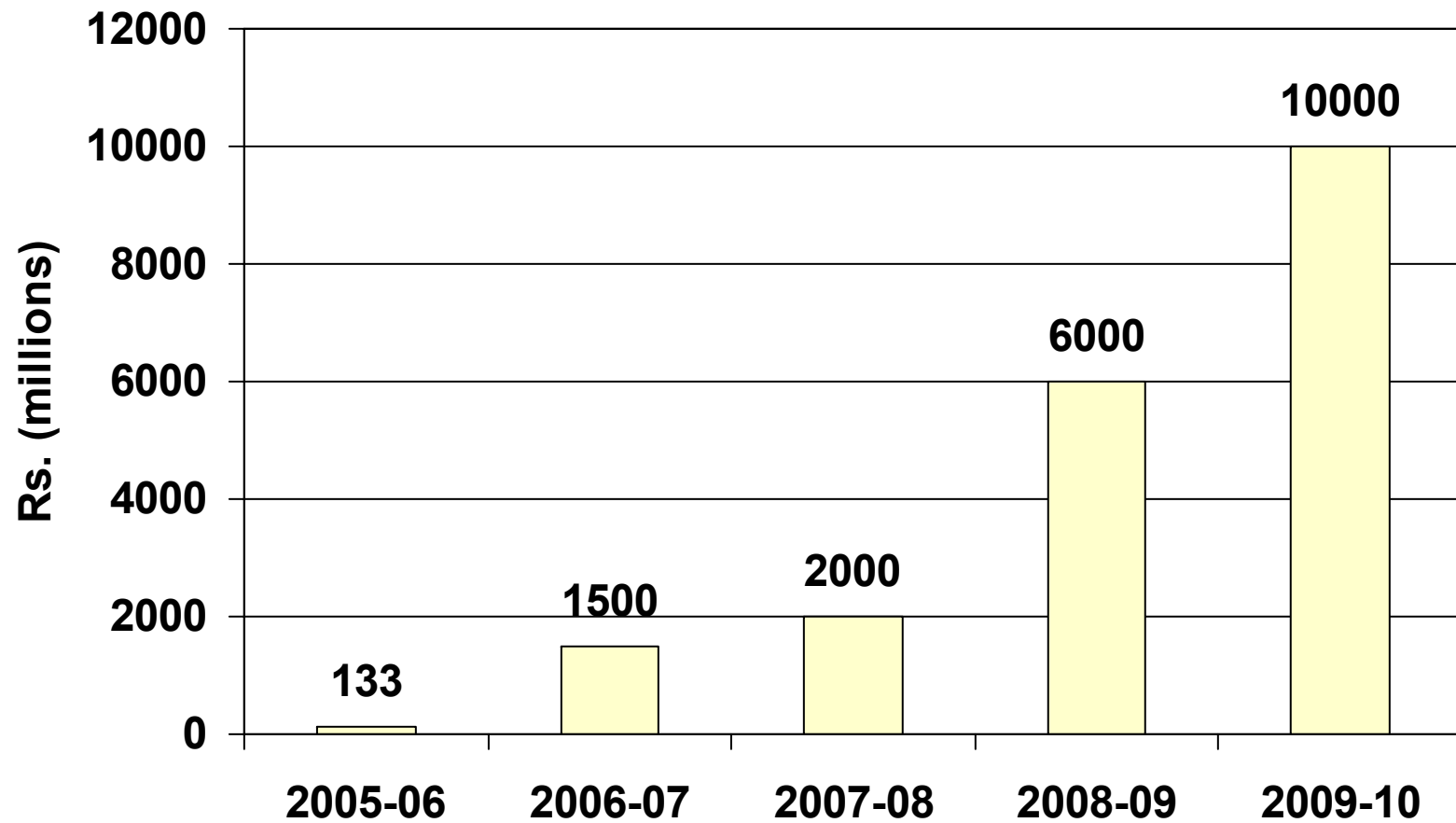
- **Mission**

- ◆ Introduce Alternative/Renewable Energy at an accelerated rate to achieve 10% share of renewable energy in the energy mix of the country

- **Set Targets**

- ◆ 800 MW by 2010
- ◆ 1,600 MW by 2015
- ◆ 3,000 MW by 2020
- ◆ 9,700 MW by 2030

AEDB Investment Plan



Initiatives and Projects by AEDB

No	Date	Project	Est. Cost
1	2004	R&D of Biodiesel Applications in Pakistan	10.00
2	2004	Pilot Project for Development and Installation of 02 Micro Hydro Kaplan Turbines	
3	May 2005	Solar Electrification at Narian Khorian	3.90
4	Mid 2005	100 Solar Homes in each Province	100.00
5	Jan 2006	Pilot Project of Production Plant of Biodiesel	21.43
6	Feb 2006	Solar Thermal Power Plant Technologies	39.80
7		Solar Water Pumping and Desalination Unit	33.04
8	Mar 2006	Development of an electrical vehicle	
9	June 2006	Socio-economic survey of remote villages & their energy demands and water requirements	
10	June 2006	Socio-economic and technical feasibility for designing water supply schemes in 400 villages of Balochistan and Sindh	

Initiatives and Projects by AEDB cont...

No	Date	Project	Est. Cost
11		Research on Development of 1kW Fuel Cell Vehicle	4.03
12		Development of Supply Chain Mechanism for Pedal Generator, Hand Generator and LED Lanterns	3.00
13		Block Allocation for four projects	200.00
14	Aug 2006	Feasibility Study for Development of a Master Plan for Establishment of an Institute for Renewable Energy Tech.	
15	Sep 2006	Feasibility for Waste Energy Plants in Ten (10) Cities of Pakistan	
16		Solar Homes Program	50.35
17		Electrification of 300 Villages	887.71
18	Nov 2006	Supply of Solar PV Lantern System	
19	Feb 2007	Baseline Capacity Assessment of PMD, AEDB, NEPRA	
20	Aug 2007	Study of Grid Integration with Wind Farms in Pakistan	
21	Aug 2007	Environmental Impact Assessment Study of Gharo Corridor	

Initiatives and Projects by AEDB cont...

- AEDB is also funded by Donors in numerous projects:

Date	Project	Agency	Cost (US\$ Mn)
Feb 2004	Renewable Energy Development	ADB	0.55
2006	Renewable Energy Development Sector Program	ADB	510.00
Mar 2007	Pakistan: Renewable Energy Policy Formulation and Capacity Development of AEDB		0.80

Projects Initiated by Donors

- Many projects have been initiated by Donor Agencies themselves. Some major projects are:

Date	Project	Agency	Cost (US\$ Mn)
Feb 2004	Commercialization of Wind Power Potential in Pakistan	UNDP	0.47
2004/5	Pak German Tech Cooperation Prog	GTZ	3.50 (Euro)
2006/7	Exploitation of Untapped Potential of Wind Energy	UNDP-GEF	3.10 + 0.72 (GoP)

Holistic View of Input vs. Output

- RE production in 2004 = 0 MW
- In last three years Billions of rupees have been spent by Government bodies (AEDB, PCRET) and Donors in renewable energy projects (some projects are still continuing)
- Today RE Production (2007)

0 MW

*The **Big** Question*

- Why?
- Usually costs US\$ 1-2 million
 - ◆ For 1 MW power plant
- With the money spent in last three years
 - ◆ Pakistan would have constructed thermal/hydro power plants of more than 500 MW capacity
- So Why?



Possible Answers



- More money needs to be pumped in
- More research is needed
- More organizations should be working in renewable energy area
- There are too many organizations working
- Renewable energy organizations do not have required powers to implement such projects
- The strategies being opted are not applicable in Pakistan
- We are not counting human factors here



Strategy



- In our opinion, the strategies being used to pursue renewable energy systems in Pakistan need to be updated

A New Strategy

A horizontal bar with a green gradient, transitioning from a lighter green on the left to a darker green in the center and back to a lighter green on the right.

A New Strategy

- Overhaul required in top-down manner
- Step 1 (Policy)
 - ◆ Change the way progress is measured
 - Progress will not be measured by projects initiated
 - Progress will be measured in terms of number of megawatts of energy produced
- Step 2 (Policy)
 - ◆ Identify a Vision
 - Produce at least 5% of the total electricity generating capacity of the country (i.e. 9,700 MW) by alternative energy sources by the year 2030 [Vision 2030, 85]; AND
 - Use renewable energies to decrease pollution and help **improve social and economical lives of rural population**

A New Strategy cont...

● Step 3 (Policy)

- ◆ Identify needs in renewable energy area in short and long term
- ◆ Short Term
 - Development = Erect electricity generating power plants from proven technologies
 - Import = Yes, if quicker than indigenous development
 - Research = Too costly (No)
 - RE Experts = Give scholarships in RE area
- ◆ Long Term
 - Development = Power plants based on new technologies
 - Import = Not all technologies. At least one technology, e.g. Solar Thermal should be mastered at home
 - Research = Yes, at all costs
 - RE Experts = RE degree awarding institution

A New Strategy cont...

● Step 4 (Practical)

- ◆ Pilot projects of all renewable energy technologies having potential in Pakistan
- ◆ These projects should be through public private partnership
- ◆ These projects should be in easily accessible areas, around 1 MW capacity
 - Wind Farm Project – AJK
 - Solar Thermal Project – Choolistan
 - Biodiesel Electricity Production – Punjab, AJK
- ◆ **Integrate these projects with the vision to improve social and economical lives of rural population**

Village Electrification (Old Strategy)

- A very good cause
 - ◆ Use renewable energy to electrify remote villages
 - ◆ In depth cost and benefit analysis required
 - 20 million rupees per village electrified (100 homes)
 - One light bulb, one electric fan and one or two other electrical appliances, e.g. water pumps
- True, even a light bulb is a life changing moment, but this process has to be seen in a socio-economic context of the location
 - ◆ Once lighted, village will still be in wilderness with little or no access to outside world
 - ◆ Still remain illiterate
 - ◆ Still have no information on better farming techniques
 - ◆ Still no access to basic health necessities
 - ◆ Still have to starve when crops fail
 - ◆ Would still be living at the same status 30 years from now, as were 30 years back

Village Electrification (Old Strategy)

cont...

- An analogy for provision of a light bulb in a remote home
 - ◆ A brail book to a blind person who cannot read brail – he might be amused but no practical benefit
 - ◆ Teach him to read brail, potential of benefit becomes unlimited
- Similarly, village electrification should be part of a complete package
 - ◆ The package should consist of a concrete socio-economic uplift scheme of the entire community – be that in a long term

Village Electrification (New Strategy)

- Majority of Pakistani villages can be grouped under the two following scenarios
 - ◆ Very small village in a far flung location
 - Balochistan, Choolistan, AJK
 - ◆ Village with sizeable population
 - Punjab, Sindh
- Pilot Projects of renewable energy should coincide with village electrification, providing double benefit



Methodology for Pilot Projects

Wind, Solar, Biodiesel

- Initial Investigation Report
- Socio-Economic Study and Technical Feasibility
- Project Implementation

Socio-Economic Study

- What are the requirements of the target audience?
- Socially and economically at what level they should be taken and in how many years
- What is required to achieve that level
 - ◆ e.g. including renewable energies, they might be benefited from Information and Communication Technologies (ICTs) as well
 - ◆ They might have to be moved for reasons like unhealthy soil content
- Draw out a blue print of the overall system to be implemented
 - ◆ e.g. should it include a school
- What are the choices for implementation strategies to install the system
 - ◆ e.g. should it be completely funded by Donors
 - ◆ Should the complete system be installed in phases
- Concrete milestones with strict deadlines to achieve the listed socio-economic level
- Total cost for the project

Project 1: Choolistan

A horizontal decorative bar with a green gradient, transitioning from a lighter green on the left to a darker green in the center and back to a lighter green on the right.



Scenario



- Choolistan is one of the least developed areas of Pakistan
- People of Choolistan are nomadic
- Choolistan has great tourism potential usually in Winter season
- Choolistan has one of the best solar thermal resource



What to do?




- Build 1 MW Solar Thermal Power Plant
- Construct number of resorts and related facilities around the power plant
- Build facilities like school, clinic near the power plant for local community

How to do?

- Donor-Industry partnership
- The firm will be given money for the project, will construct the power plant and provide free electricity to the community which comes to live near the plant, for number of years as negotiated
- Firm will be allowed to sell electricity to other commercial entities, as long as it fulfils the requirements of the local population
- Choolistan people are nomadic, but would come to the resorts with the prospects of jobs at least in the winter season
 - ◆ Educate their children during that time, and provide them training to earn revenue from the tourism

Project 2: Punjab

A horizontal decorative bar with a green gradient, transitioning from a lighter green on the left to a darker green in the center and back to a lighter green on the right.



Scenario



- Less fertile regions of Punjab ideal for biodiesel crops such as Jatropha
- Punjab has comparatively larger villages and number of villages in close vicinities to each other
- People are accustomed to farming


What to do?

- Build 1 MW Biodiesel Power Plant
- Choose a location near the grid where a couple of villages are without basic necessities like schools, clinic
- Build facilities like school, clinic near the power plant for local community

How to do?

- Donor-Industry partnership
- Convince a firm to setup a biodiesel plant and help it procure loan for the plant and provide assurance for adequate supply of biodiesel for a number of years, at prices lower than imported diesel
- Give funds to the farmers to grow a biodiesel crop like Jatropha with assurance for sale
- Power Plant will sell electricity to WAPDA and villagers will purchase electricity either through WAPDA or directly from the Power Plant
- As children work in the fields in the day time, the school timings should be in the evening, when children are free
 - ◆ With electricity now available, it would be possible to study in the evening

Project 3: AJK

A horizontal decorative bar with a green gradient, transitioning from a lighter green on the left to a darker green in the center and back to a lighter green on the right.



Scenario



- People still recovering from October 2005 earthquake
- Many still living in temporary shelters
- Muzaffarabad and Mirpur having good potential for Wind Energy
- IPP industry very active in renewable energy



What to do?



- Build 1 MW Wind Farm
- Choose a location where rehabilitation is needed
- Build an entire village with houses, schools and other necessities



How to Do?



- Donor-Industry partnership
- The firm will be given money for the project, will construct the power plant and provide free electricity to the community near the plant, for number of years as negotiated
- Firm will be allowed to sell electricity to other commercial entities, as long as it fulfils the requirements of the local population

Renewable Energy Technologies

A horizontal decorative bar with a green gradient, transitioning from a lighter green on the left to a darker green in the center, and back to a lighter green on the right. It is positioned below the main title.

Renewable Energy Technologies for Pakistan

- **Bio Fuels**
 - ◆ Fuel Ethanol
 - ◆ Biodiesel
- **Hydropower (mini and micro)**
- **Solar Thermal Power**
- **Wind Mills**
- **Tidal Power Generation**
- **Pressure Reduction Station Generators**



Energy Technologies of Future



- Fuel Cells
- Fusion Energy
 - ◆ Helium-3 (^3He) to be mined from moon
- Blue Energy
- Thermophotovoltaic Cells
- Space Solar Power Plants



Recommendations



- Three Pilot Projects need to be implemented within a period of two years
- Socio-economic uplift of rural Pakistan through renewable energies need to be complemented with other technologies like Information and Communication Technologies (ICTs) and supportive plans
- Pakistan needs to start preparing for transition to Hydrogen Economy, for which renewable energy is the first step

Recommendations cont...

- Local industry needs to be included directly if possible and as much as possible
 - ◆ Firms with proven track records in energy sector area are more suited for this purpose
- Research and Development Fund for renewable energies need to be setup
- Qualified scientists/engineers in renewable energy sector should be produced
 - ◆ In longer term a renewable energy institute should be setup
- AND
- Progress should be measured in amount of megawatts produced

Thank You



In 2007 power failures registered
a rise of 23% compared with 2006

A Fact